Impact of the CIF Program on NASA's Autonomy Capability: the NASA Platform for Autonomous Systems (NPAS)

The CIF Program provided support to advance the autonomous operation technology that was at a low TRL scale to push the technology to a higher TRL where then other programs could sponsor further advances and infusion of the capability into other projects. This is the case with NPAS.

User Interface of the NPAS Autonomous Vehicle Manager for a Space Habitat (AES Integrated Avionics-Power-Software Lab, NASA JSC)

Autonomy capability encompasses technologies that enable a system to function independent from operators, except for times of low frequency high level interactions. With this degree of autonomy, the system has to be able to determine its condition (Integrated System Health Management – ISHM), and apply ***autonomy strategies*** that permit progression towards achieving a mission, in spite of anomalies or external unforeseen disturbances.

SSC's development of autonomy capability has been underway for over a decade, encompassing development of expertise, processes, and technologies required to implement this ability. Processes and technologies for autonomous systems and applications are encompassed by NPAS. NPAS represents an innovative approach and technology to rapidly implement and deploy intelligent/thinking autonomous operations. NPAS contains tools for creating an integrated autonomy solution: comprehensive (real-time) operational knowledge models (beyond the comprehensiveness of SysML models) – capturing digital twin/digital thread information, health assessment, diagnostics, anomaly detection (FMEA), autonomous operational strategies, mission plan scheduling and execution (https://techport.nasa.gov/view/94884).

NPAS Autonomous Operations of the nitrogen system at the SSC High Pressure Gas Facility

The CIF program has been instrumental in developing the foundational technology for 2 specific areas of NPAS: (1) the ability to enable "thinking" and reasoning using physics (or other) models, and (2) development of an ontology (taxonomy, language, dictionaries) to enable autonomous creation/scheduling/execution of plans and reasoning at high abstraction levels needed for human-like behavior and for distributed autonomy.

Technology development supported by CIF has been leveraged by Advanced Exploration Systems (AES) and Rocket Propulsion Testing (RPT). AES has supported further development of NPAS for potential use in space habitat modules, Gateway, robotic ISRU (AES/STMD), and systems for outposts on the Moon and Mars. RPT is supporting infusion of NPAS to implement autonomous operations on ground facilities. The first implementation is autonomous operations of the nitrogen system at SSC's High Pressure Gas Facility.

RELEASED - Printed documents may be obsolete; validate prior to use.